ACADEMIE DU ROYAUME DU MAROC

DISCOURS

~~AMENDED VERSION~~

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By Donald S. Fredrickson, M.D.
On the occasion of his introduction
to the Academy of the Kingdom of Morocco

Mr. Permanent Secretary,
Mr. Chancellor,
Director of Seance,
Honored Colleagues and Guests:

I am deeply honored to have been chosen to join you as an Associate Member of the Academy of the Kingdom of Morocco, and to share in its high purposes. Over the past few years, I have had the good fortune to become acquainted with Morocco in all of its seasons. This has included opportunity for the establishment of strong friendships with many of the people, and discovery, through them, of the rare qualities of this land.

I wish to express my highest respect for His Majesty, King Hassan II, from whose hand I received the invitation to this investiture. His wisdom in establishing this institution and, thus, creating a unique place where the search for intellectual and spiritual union may continue, will be much rewarded by history.

I also have been paid a high honor today in being introduced by Professor Jean Bernard. I know him as a friend and as one of the most distinguished citizens of France. Professor of medicine and hematologist at the University of Paris, a member of the Academie Francaise, and one of the world's finest physicians and medical scientists, he is a true natural philosopher in the best sense of that term. Above all, he is a man of delicate sensibilities, vast intellectual compass, and strong moral conviction. His introduction graciously invests with luster the pale impact on this body of my membership.

Like Professor Bernard, and doubtless like many other Members and Associate Members of the Academy, I claim more than one profession. First--and last--I am a physician. He who is trained in the arts of diagnosis and prescription and once has felt the satisfaction of restoring function or relieving pain finds it very difficult to abandon the healing role in the rest of his life.

The physician's art has long been a complicated one. In the Canon Avicenna wrote:

> Galen's art heals only the body,
> But Abou Amram's the body and soul.
> With his wisdom he could heal
> The sickness of ignorance.

Today, the physician must work ever harder to avoid ignorance of ever increasing new knowledge of sickness and health. More advanced training in the sciences is required for all who would heal. It also is necessary that some physicians must achieve a more complete synthesis of biology and medicine, both for purposes of teaching science to physicians and also for carrying out research on biomedical problems. Sometimes it is difficult to perform well in both roles. In the role of a scientist, one must respect the laws of probability. In the role of physician, however, one must believe that his hands might sometimes work a miracle. Science always has a statistical viewpoint which tends to see the individual only as a blurred image. Its laws are derived from observations of populations and apply to single persons only in a probablistic way. Medicine, on the other hand, must have consummate concern for the individual. In the interest of his patient, the physician often must work to defeat the law of the average (mean) which is derived from the population as a whole. Thus, I am among those whose profession became a hybrid between scientist-and-physician. There are great satisfactions and some special problems to be found in such a profession.

As a physician and scientist, my interests early fell on the question of how fats are transported in the arteries--the extracellular waterways--of the body. As you know from observing the behavior of oil and water, we are dealing here with a major problem. They do not mix well, and their mutual enmity must be overcome if the internal commerce of the body and life itself is to proceed. The fuel economy of all higher organisms, and the maintenance of a healthy condition of the arteries in man, depends upon a harmony between these unmiscibles. As the work of my colleagues and I helped to demonstrate, this blending is accomplished by special proteins whose structure is amicable with both oil and water, enabling them to achieve diplomatic chemical agreement.

Much of my biological work, then, has been related to identification of the specific proteins aiding transport of fat in the blood. We who work with complex mixtures, like circulating blood plasma with its hundreds or thousands of different proteins, must take care to be sure that our observations are meaningful and correct. For this purpose I chose some infallible models for instruction. I confined my studies largely to discovering and observing humans with genetic differences affecting one or another of the fat-carrying proteins. A genetic change can alter its protein product so that the protein loses its natural function. The resultant disturbances in body function certify both the essentiality of the protein and provide leads to discovery of how the protein carries out its functions.

Those of us who began work in human genetics within the last 40 years have been very fortunate. We were the children of the "biological revolution." This term is given to the series of discoveries of the chemical nature of genes (DNA), and how sequence of the DNA bases dictate the amino acid chain structure of proteins. The further elucidation of how DNA replicates and how the gene structure--and therefore the vital structure of proteins--can be changed has provided opportunity for

understanding how the characteristics of all species are transmitted from generation to generation, and how tiny molecular alterations can sometimes express themselves in much human misery.

It was only a few years ago that so-called recombinant DNA technologies were developed. These extraordinarily powerful technologies opened the way to deliberate substitution of highly specific pieces of the complement of genes (the genome) of an organism. Thus far utilized only in bacteria, such technology undoubtedly will be applicable to plants and higher organisms. Perhaps they someday will be useful to man.

Such remarkable discoveries in our time have many practical and philosophical implications. On the practical side, biological products of value to man and animals are already being created more efficiently by genetic technology. There soon may be created new plants to make the deserts bloom and to feed the hungry children of the world.

It may be possible to make beneficial changes in the genome to cure severe genetic abnormalities in man. Doubtless, the new knowledge from the biological revolution will help us understand cancers and give us new vaccines to eliminate some of the parasitic as well as viral diseases. It may, perhaps, place within our grasp the technology to give to every person born the full span of years intended.

Powerful new technologies also breed ethical and moral dilemmas about how they shall be used. What may be beneficial for all can be put to destructive use by a few. Physics experienced its last major revolution at least 50 years ago but nuclear fission still presents civilization with a terrible choice. The uses of recombinant technology arising from the present revolution in biology need not create so acrimonious a debate among nations. Yet, the capability of bringing about change in the inheritance of even one man has raised profound spiritual questions which the learned and thoughtful people of all nations must endeavor to understand and answer for themselves.

In the past decade, I have spent much time in the higher functions of government, helping to explain the implications of science--its powers and limitations--to its leaders. These experiences have given me opportunity to reflect upon the interface between science and society, upon scientific institutions, and upon science itself. One of the most interesting observations, now obvious to many, is that separate revolutions in the physical and biological sciences within the last 100 years have exposed and exaggerated differences among these sciences as profound as those between disparate cultures in human society.

The physical sciences have acquired a holistic, theoretical unity in the last century. They gradually have evolved from the classical mechanics of Newton and Galileo and, in the early part of this century, incorporated the relativity of Einstein and then quantum mechanics. It is undisputed that the physical sciences are subject to mathematical expression of universal laws. Predictability and order are at a maximum. All the molecules of a given inorganic compound are the same.

Consider biology by comparison. All of the biological sciences deal with a quantity called life, which has yet to be defined. These sciences are descriptive, empirical, and deal with seemingly endless heterogeneity. No two persons, no two organisms of the same species are absolutely identical. The capacity for variation within the genome seems almost infinite. Even for identical twins, the imprint of environmental adaptations is never precisely the same.

Yet, there are those who see in the steadily emerging knowledge the outlines of a biological theory of unity. In all living organisms there are qualities which suggest order within their vast heterogeneity. There also are elements of selection--"holistic memory"--which suggest that biological systems, too, obey quantum mechanisms. Someday, then, we may be given mathematical expressions for biological unity.

The rapidly expanding body of knowledge offers us hope for unity of the sciences or their theoretical bases. Can we expect less than to strive toward greater understanding of the fundamental unity of all people? A condition of science for its progress and the success of its method is universality of the scientific community. The same condition no doubt applies to the solution of certain practical, political, and cultural differences which divide humanity across our world.

Man is individual--everywhere different superficially—and unpredictable. Yet, man also is fundamentally the same and perfectly predictable in his striving everywhere for equivalent basic needs.

The enlightened auspices which have created this Academy of the Kingdom of Morocco have provided a rare place to search for understanding of universalities. It is located at an ancient crossroads on the earth's surface and in the world's history. The Islamic culture was not only the bridge between Hellenic ideas and the European Renaissance. It also added important ingredients to the further development of civilization. Consider the Arabic contribution of AL-JABR (ALGEBRA), meaning the binding together of disorganized parts.

Islamic science has always had a penchant for order and unification. It did not concern itself only with man's physical being and environment. It also mounted analyses of man's spiritual being and of his societies. In Arabic, knowledge of the universe has been called FALSAFA. It embraces all knowledge within the grasp of man, theoretical and practical alike.

The Islamic legacy to science and human understanding is exemplified by the classical writings of Ibn Khaldun. He set a standard of scholarship which will serve our deliberations.

If we are to gain one grain of greater understanding of the universe where have we a better place to begin that search? I look with pleasure upon the opportunity to join the Academy of the Kingdom of Morocco in that quest.